AD-A061 070   NAVAL POSTGRADUATE SCHOOL MONTEREY CALIF   F/G 9/2
COMPUTER SELECTION AND EVALUATION.(U)
JUN 78   A N BAYRAKTAR

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EQ. 3 for real time systems multiprogramming
background batch jobs

$$\text{Average throughput rate} = \frac{\text{(Representative transaction workload + representative batch workload) successfully completed during an evaluation period}}{\text{Wall clock system hrs. expended to process that workload}}$$

EQ. 4

$$\text{Capability} = \text{Maximum achievable average throughput rate regardless of the timeliness of outputs over a given time period}$$

EQ. 5

$$\text{Operational capability} = \text{Maximum achievable average throughput rate while meeting timeliness requirements}$$

EQ. 6

$$\text{Relative throughput rate} = \frac{\text{Average throughput rate for evaluation 1}}{\text{Average throughput rate for evaluation 2}}$$

EQ. 7

$$\text{Relative capability} = \frac{\text{Capability for evaluation 1}}{\text{Capability for evaluation 2}}$$

EQ. 8

$$\text{Percent unused capability} = \frac{(\text{Capability} - \text{average throughput rate})\ 100}{\text{Capability}}$$

EQ. 9

$$\text{Percent throughput rate change} = (\text{Relative throughput rate} - 1)\ 100$$

EQ. 10

$$\text{Turnaround time} = \text{Elapsed time in hrs., min. or sec. between arrival or first character of first input at input interface and arrival of last character of final output required by that input at output interface}$$

EQ. 11

Response time = Elapsed time in sec. between arrival of last character of an input transaction at input interface and arrival of first character of final output at output interface

EQ. 12

$$\text{Elapsed time multiplication factor (ETMF)} = \frac{\text{Turnaround time of a specific job processed in a specific multiprogrammed environment}}{\text{Turnaround time of the same job processed as the only job in the same system}}$$

EQ. 13

Equivalent throughput rate of N independent systems

= Sum of throughput rates of N systems

= Throughput rate + Throughput rate +... + Throughput rate
  of system 1   of system 2   of system N

EQ. 14

Equivalent capability of N independent systems

= Sum of capabilities of N systems

= Capability of + Capability of + ... + Capability of
  system 1   system 2   system N

APPENDIX B

HARDWARE CHECKLIST

A. Central Processing Unit (CPU)

1. Organization (word and/or byte oriented)

2. Processor storage characteristics:

Real, buffered or virtual processor storage; core or monolithic; amount reserved for firmware; net amount available for operating system and problem programs. Amount of low-speed storage included, if any.

3. Complement of registers

4. Memory cycle time

5. Average "access to processor storage" time

6. Number of words or bytes accessed per cycle

7. Instruction repertoire

8. Instruction mix timing (average execution time)

Example: (5-byte unpacked fields)

a. $c = a + b$

b. $c = a + b$

c. $c = a + b$

d. Move a to b

e. Compare a to b and branch

Instruction mix should be chosen based on expected use. For instance, if a significant amount of floating-point work is expected, then these instructions should also be timed.

If the arithmetic instructions are performed in the registers, the loading to and storing from registers should be included in the timings.

9. Special power unit required

10. I/O channels

    a. Number of channels by type (selector, multiplexor, or block-multiplexor)

    b. Maximum speed of each

    c. Attachable units (or excluded units)

    d. Switching capability of attachable units

    e. Simultaneity of operation between CPU and the I/O units, as well as between the I/O units themselves

    f. In-board channel (CPU acts as channel processor) or out-board channel (channel processor separate from CPU)

    g. Channel diagram of proposed system

    h. Attachable to another CPU

11. Integrated controllers

    a. Attachable I/O units

    b. Limitations on which integrated controllers may or may not be core resident

    c. Degradation of CPU performance caused by the integrated controllers

12. Timers/clocks

    a. Resolution or precision

    b. Maximum time accumulation

    c. Interrupt triggers

    d. Difficulty in setting

    e. Time of day or interval timers

13. Power failure protection

    a. Emergency off-automatic shutdown sequence

    b. Power fail safe

    c. Standby or secondary power source

14. Storage protect capabilities

    a. Number of separate areas protected

    b. Fixed areas or software controllable

    c. Minimum area protectable

15. Compatibility/emulation features

    a. Machines emulated

    b. Software requirements

    c. Limitations

16. Expandability

    a. Other features available

    b. Maximum storage and channels

B. Magnetic Tape Units

    1. Number of units

    2. Number of controllers

    3. Densities supported, single or dual

    4. 7-Track/9-Track

    5. Operating characteristics: Mounting operation (auto-load or manual), tape cartridge required or usable, fixed or rotatable dial, stress and wear on tape (number of capstans, vacuum column, tension arms)

    6. Continuous or incremental recording

    7. Transfer rate

    8. Start/stop time

9. Rewind time

10. Formula for computing effective speed

11. Error-checking and correcting capability

12. Automatic or manual switching (between CPUs, channels, controllers)

13. Expandability: maximum number of units per controller, controllers per CPU

C. Card Read/Punch

1. Rated speed (reflects maximum speed)

2. Time to process one card (converted to cards per minute, this reflects minimum speed)

3. Card codes supported

4. Number of stackers and capacity of each

5. Number of hoppers and capacity of each

6. Error-checking capability

7. Buffered, interlocking or cycle steal

8. Special features: 51 column, punch-feed-read, mark sense, and so on

9. Capability for sorting, collating, interpreting (card print)

10. Noise level

11. Reliability

12. Controller characteristics and limitations

D. Printer

1. Rated speed (for designated character set)

2. Time to print one line

3. Number of print positions

4. Width of form (maximum and minimum)

5. Quality of print (single and multiple form)

6. Character set

7. Skip speed

8. Carriage tape specifications

9. Lines per inch

10. Noise level

11. Stacker characteristics

12. Reliability

13. Buffered, interlocking or cycle steal

14. Controller characteristics and limitations

E. Disk or Drum

1. Capacity

2. Transfer rate

3. Access time (seek and rotational delay)

4. Removable packs or fixed head storage

5. Special features (such as rotational position sensing)

6. Channel restrictions (such as attachable only to channel number one, or only device on the channel)

7. Controller characteristics and limitations

8. Expandability

9. Reliability

F. Operator Console

1. CRT or printer

2. Keyboard

3. Speed

4. Width of display

5. Number of display lines visible to operator

6. Character set supported

7. Location relative to CPU and I/O units

8. Noise level

9. Reliability

10. Special paper or stock form

11. Stacker for paper

12. Ribbon required-expected life

G. Paper-Tape Reader/Punch

1. Speeds (transfer rate, start/stop time)

2. 7- or 9-channel tape

3. BCD, EBCDIC or ASCII code

4. Feed and take-up reels or fanfold

5. Rewinding required

6. Checking capability

7. X-on and X-off required

8. Compatibility with source or destination of tape

9. Splicing considerations

10. Reliability

H. Telecommunications

1. Controllers (data adapters)

    a. Number of lines supported

    b. Speed of transmission

    c. Leased line or dial-up

    d. Synchronous or asynchronous

    e. Types of terminals supported

    f. Interchange code supported

g.   Features supported (such as paper tape, answer-
back, auto-call, multiple-record transmission, polling)

h.   Buffered

i.   Duplex or half-duplex transmission

j.   Error correction/recovery

2.   Modems - See above and below

3.   Communication facility

a.   Leased or dial-up

b.   Multiplexed line

c.   Duplex or half-duplex transmission

4.   Terminal

a.   Type of display (CRT or hard copy)

b.   Input modes (such as keyboard or tape cassette)

c.   Speed

d.   Width of display

e.   Number of lines visible to operator

f.   Interchange code used

g.   Special paper or stock form

h.   Impact or thermal printer

i.   Multiple copies

j.   Paper-stacking facility

k.   Intensity adjustment

l.   Visibility of cursor

m.   Error correction/recovery

n.   Hard-wired or acoustic coupler

o.   On-line or off-line transmission

I. Other Equipment

Many other types of equipment may be available to attach
to or be used in conjunction with the computer system. Each
requires various considerations regarding performance, suit-
ability for the purpose, compatibility with other units,
reliability, operator interface and physical characteristics.
Listed below are some of these types of equipment:

1. Microfilm/microfiche

2. Plotters/graphics

3. OCR scanner

4. Array processor

5. Audio response

6. MICR

7. Manual or automatic switching units

Many other considerations such as power requirements, air
conditioning, humidity control, floor space, and so on, apply
to all the hardware.

APPENDIX C

SOFTWARE CHECKLIST

A. Operating System

    1. Resident device(s)

    2. Amount of direct-access storage dedicated to operating system and work space required

    3. Processor storage reserved for operating system

    4. Support for anticipated I/O devices

    5. Extent of multiprogramming capability and limitations

    6. Proposed method of card I/O and print processing (SPOOL)

    7. Preexecution I/O device setup

    8. Ease of operation

    9. Acceptability of operator messages

    10. Access methods available

    11. Virtual storage-optional or required

    12. Support of automatic switching between channels

    13. Compatibility or emulation support-capabilities and limitations

    14. Complexity and capability of job-control cards/language

    15. Job-accounting facilities

    16. Operating system and hardware performance statistics

    17. Telecommunication facilities (Remote Job Entry, direct data entry/retrieval, time-sharing, and so on)

    18. Clarity of error codes/messages

19. Data-base management features

20. Facilities for user program library

B. Compilers/Assemblers

   1. Languages supported

   2. Adherence to national standard languages and features

   3. Processor storage required for execution

   4. Work space required on direct-access storage

   5. Maximum program size allowable (number of source statements)

   6. Devices not supported

   7. I/O addresses absolute or generic

   8. Subroutine libraries available

   9. Suitability of languages to meet expected needs

  10. Telecommunication features

  11. Clarity of diagnostic codes/messages

C. Sort/Merge

   1. Maximum/minimum file size

   2. Maximum/minimum record size

   3. Fixed/variable record lengths

   4. Blocking

   5. Number of fields in key-maximum key size

   6. Devices used/required/supported

   7. Formulas/tables to compute processor storage and I/O storage required

D. Utility Program

   1. List of utility programs available

   2. Completeness of list to meet needs

E. Performance

    1. Estimate sort timings

    2. Estimate compile/assemble rate

    3. Estimate operating system overhead

    4. Estimate processing time of problem programs

    5. Estimate compatibility/emulation performance

    6. Predict total throughput of work load including operator functions and multiprogramming performances

    7. Benchmark representative sample to confirm performance

    8. Use of simulation where advisable

F. System Preparation Requirements

    1. SYSGEN plan

    2. On-site or remote

    3. Minimum system required to perform SYSGEN

    4. Amount of time required

    5. Degree of testing needed

    6. Vendor assistance

    7. Education required

G. Software Availability/Reliability

    1. How long in use by other installation (or when available)

    2. Other users' experience

    3. Software maintenance

        a. Normal period between updates

        b. Difficulty to maintain

        c. Availability of vendor assistance

BIBLIOGRAPHY

Auerbach Publishers, Inc., "Selecting a Small Business Computer," Data Processing Management, 1975.

Auerbach Publishers, Inc., "Requirements Costing: A Superior Computer Evaluation Methodology," Data Processing Management, 1975.

Auerbach Publishers, Inc., "Long Range Planning for EDP," Data Processing Management, 1976.

Auerbach Publishers, Inc., "Configuring the Computer System," Data Processing Management, 1977.

Auerbach Publishers, Inc., "Checklist for Evaluating Mini-computer Vendor Policies," Data Processing Management, 1977.

Basinoff, P., "Volume Buys Mean Volume Savings," Purchasing, p. 37, 18 December 1973.

Borovits, I., "Computer Selection and Acquisition," Data Processing, v. 17, no. 2, p. 98-100, March-April 1975.

Borovits, I. and Golembo, E. I., "Measuring Computer Performance," Journal of Systems Management, p. 38, November 1973.

Bucci, R. A., "Beware the Standard Lease," Datamation, p.75, March 1973.

Burroughs Clearing House, Burroughs Reports, v. 60, no. 11, p. 22, August 1976.

Chorafas, D. N., Selecting the Computer System, Gee & Co. Limited, 1967.

Clifton, H. D., Systems Analysis for Business Data Processing, Auerbach Publishers, Inc., 1969.

Computerworld Gazette, 16 January 1978.

Coop, D. H., An Analytical Approach to the Measurement, Evaluation, and Prediction of Computer Performance, 1971.

Coutinho, J. S., Advanced System Development Management, Wiley Interscience, 1977.

Data Center Dialog, v. 1, "Avoiding Power Outages - The UPS Option," February 1978.

Datamation, p. 59, "Comparing Costs on IBM Rental Plans," August 1972.

Datamation, v. 22, no. 1, p. 125, "Getting Around the Supply Schedule," January 1976.

Datamation, p. 186, "Should Happiness Come With a Price?," March 1976.

Dearden, J. and Nolan, R. L., "How to Control the Computer Resource," Harvard Business Review, p. 68, November-December 1973.

Department of Defense Computer Institute, DODCI Course Catalog, October 1976.

Doherty, W. J., "Scheduling TS5/360 for Responsiveness," AFIPS Proc. FJCC, p. 97-111, 1970.

Ein-Dor, P., "A Dynamic Approach to Selecting Computers," Datamation, p. 103, June 1977.

Eldin, H. K. and Croft, F. M., Information Systems, 1974.

Emery, J. C., Can We Develop Cost-Effective Information Systems?

Ferrari, D., "Workload Characterization and Selection in Computer Performance Measurement," Computer, p. 18-24, July/August 1972.

Ferrari, D., "Tailoring Programs to Models of Program Behavior," IBM Journal of Research and Development, v. 19, no. 3, p. 244, May 1975.

Fleet Materiel Support Office (UADPS-SP), Time Analysis and Billing System (TABS), 1976.

Fleming, D. M., "An Accountant's Dream Come True," CA Magazine, v. 110, no. 3, p. 28, March 1977.

Fowler, M. H. and Starr, D. E., "Point of Indifference in Lease or Buy Decisions," Financial Executive, p. 8, March 1974.

Foy, N., Computer Management - A Common Sense Approach, Auerbach Publishers, Inc., 1972.

Gibson, J. C., The Gibson Mix, IBM TR 00.2043, June 1970.

Gustafson, G. A., "Computers - Lease or Buy?," Financial Executive, v. 41, p. 64, July 1973.

Hatfield, D. J., "Program Restructuring for Virtual Memory," IBM System Journal, v. 10, no. 3, p. 168, 1971.

House, W. C. and Shankle, J. E., "Choosing the Right Computer," Journal of Educational Data Processing, v. 3, no. 3, 1976.

House, W. C. and Shankle, J. E., Utilization of Cost/Effectiveness Models to Evaluate User Trade-Off in Terminal Selection, 1978.

Hunter, J. J., "Measure for Measure," Computer Decisions, v. 8, no. 9, p. 54, 1976.

Joslin, E. O., Application Benchmarks - The Key to Meaningful Computer Evaluation, 1965.

Joslin, E. O., Computer Selection, The Technology Press, 1977.

Krauss, L. I., Administering and Controlling the Company Data Processing Function, Prentice Hall, Inc., 1969.

Los Alamos Scientific Laboratory of the University of California, Evaluation of Computer Software.

Martin, J., Design of Man-Computer Dialogues, Prentice Hall, Inc., 1973.

McKinsey and Company, Inc., Unlocking the Computers' Profit Potential, 1963.

Naval Electronic Systems Engineering Center, ADS Development Plan, 11 January 1977.

Naval Supply Systems Command, Planning at NAVSUP.

Naval Supply Systems Command, "Automation of Procurement Accounting Data Entry, APADE, II," ADS Development Plan, 1977.

Nielsen, G. O., "How Maintainability Pays Off," Mini-Micro System, v. 9, no. 11, p. 42, November 1976.

Nolan, R. L., "Controlling the Cost of Data Services," Harvard Business Review, p. 114, July-August 1977.

Olson, G., "How to Choose a Bespoke System," Computer Weekly, v. 21, no. 524, p. 37, 18 November 1976.

Prokop, J., Computers in the Navy, 1976.

Randolph, J. M., "Computer Leasing Today," Financial Executive, p. 50, May 1974.

Raphael, H., "Simplify Low-Cost UP Selection with Tabulated Data," Electronic Design, v. 25, no. 5, p. 60, March 1977.

Reps, D., "Input/Output Cost Matrix," Hospital Financial Management, v. 31, no. 1, p. 31, January 1977.

Roenfeldt, R. L. and Fleck, R. A., "How Much Does A Computer Really Cost?," Computer Decisions, v. 8, no. 2, p. 77, November 1976.

Rogaw, B. J., "Should EDP Cost Be Charged Back to the User," Advanced Technical Training, IBM Corporation.

Rosen, S., Lectures on Measurement and Evaluation of the Performance of Computing Systems, Society for Industrial and Applied Mathematics, 1976.

Rothery, B., The Myth of the Computer, Business Books, 1971.

Sabol, T. A., "Purchasing a Computer," Management Accounting, p. 43, October 1972.

Schneidewind, N. F., Analysis of Computer Performance in Multiprogrammed Processing, 1975.

Sekino, A., "Performance Evaluation of Multiprogrammed Time Shared Computer Systems," Technical Report, MIT, Cambridge, Massachusetts, September 1972.

Sinnott, M., "Tune-up For Better Performance," Data Processing, v. 10, no. 6, p. 12, 1976.

Sippl, C. J. and Sippl, C. P., Computer Dictionary and Handbook, Howard W. Sams and Co., 1972.

Skyrme, D. J., "Computer Graphics - Part 1 - Choosing a System," Computer Aided Design, v. 3, no. 3, p. 18-23, Spring 1971.

Shope, W. L., Kashmarack, K. L., Inghram, J. W. and Decker, W. F., "System Performance Study," Proc. Share XXXIV, v. 1, March 1970.

Sollenberger, H. M., Management Control of Information Systems Development, National Association of Accountants, 1971.

Stimler, S., Data Processing Systems - Their Performance Evaluation Measurement and Improvement, Motivational Learning Programs, Inc., 1974.

Svobodova, L., "Computer System Performance Measurement," Technical Report, no. 66, Digital System Laboratory, Stanford University, June 1974.

Svobodova, L., Computer Performance Measurement and Evaluation Methods: Analysis and Application, Elsevier Publishing Company, Inc., 1976.

Szatrowski, T., "Rent, Lease, or Buy?," Datamation, p. 59, February 1976.

Tatham, L., The Use of Computers for Profit, McGraw-Hill, 1969.

Thrussell, C., "Purchasing A Computer," Computer Bulletin, Series 2, no. 10, p. 28, December 1976.

University of Michigan, A Performance Comparison of All-Digital Computation and the Advanced Hybrid Computer Systems, 1975.

Webster, G. J. and Johnson, C. W., "The Evaluation and Selection of a Computer System for Interactive Design," Computer Aided Design, v. 8, no. 4, p. 247, October 1976.

Withington, F. G., "Five Generations of Computers," Harvard Business Review, p. 99-108, July-August 1974.

Withington, F. G., "Beyond 1984: A Technological Forecast," Datamation, p. 54, January 1975.

Wolin, L., "Procedure Evaluates Computers for Scientific Applications," Computer Design, v. 15, no. 11, p. 93, 1976.

Wooldridge, S., Software Selection, Auerbach Publishers, Inc., 1973.

Yearsley, R. B. and Graham, G. M. R., Handbook of Computer Management, Gower Press, 1973.

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